

Performance of 35-Pound Fiberboard Boxes Jumble-Packed with Peaches and Nectarines

Marketing Research Report No. 1077

RETURN TO GOV. DOCS. CLERK

Agricultural Research Service
UNITED STATES DEPARTMENT OF AGRICULTURE

ABSTRACT

R. E. Rij. Performance of 35-pound fiberboard boxes jumble-packed with peaches and nectarines. U.S. Department of Agriculture Marketing Research Report 1077, 12 pp., 1977.

California shipped approximately 18 million boxes of fresh peaches and nectarines in 1975. Seven test shipments were conducted in 1975 to determine if fruit could be shipped successfully in fiberboard boxes with net weights of 35 instead of 25 pounds. We also compared the relative advantages of Bliss-style and tray-style design corrugated fiberboard boxes. During 40 hours of transit, peaches averaged 54° F (12° C) in 25- and 35-pound fiberboard boxes. Nectarines averaged 48° (9° C) in the 25- and 35-pound fiberboard boxes during 96 hours of transit. However, these temperatures were higher than recommended for fruit shipments. All containers were in good condition on arrival, and no significant difference in fruit quality was detected between the fruit packed in the 25-pound fiberboard box or that packed in the 35-pound fiberboard box. About \$1.5 million a year could be saved by using 35- instead of 25-pound corrugated fiberboard boxes for peaches or nectarines. KEYWORDS: Peaches, nectarines, shipping containers, marketing unitization, corrugated fiberboard boxes, fruit quality.

ACKNOWLEDGMENTS

The cooperation and assistance of the following firms are gratefully acknowledged:

California Tree Fruit Agreement, Sacramento, Calif.

Grand Union Co., Inc., Paterson, N.J.

Ito Inc., Reedley, Calif.

Kash Inc., Parlier, Calif.

Milgram Foods Inc., Kansas City, Mo.

Topco Assoc., Reedley, Calif.

The author also appreciates the assistance of Louis Beraha, U.S. Department of Agriculture (USDA), Agricultural Research Service (ARS), Chicago, Ill., and William Tietjen, USDA, ARS, New Brunswick, N.J., in meeting test shipments, and Jerry Schuyler, USDA, ARS, Fresno, Calif., in making test shipments.

Trade names and the names of commercial companies are used in this publication solely to provide specific information. Mention of a trade name or manufacturer does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture nor an endorsement by the Department over other products not mentioned.

CONTENTS

	PAGE
Introduction	1
Methods and materials	1
Results	3
Temperature	3
Container condition	3
Fruit condition and maturity	4
Condition of fruit in retail store	5
Discussion	6
Literature cited	7

Performance of 35-Pound Fiberboard Boxes Jumble-Packed with Peaches and Nectarines

By ROGER E. RIL¹

INTRODUCTION

In 1975, California shipped more than 18 million boxes of fresh peaches and nectarines, which had a market value of over \$70 million (2, 3).² Shipments of peaches and nectarines from California have increased 32 percent since 1971 (2, 3). New plantings of peaches and nectarines in the last 2 years will increase shipments in the future (1).

Traditionally, the most commonly used shipping container for peaches and nectarines has been a hand-packed, two-layer wooden lug box with a net weight of 22 lb. New fruit sizing equipment, improved designs of corrugated fiberboard boxes, along with automatic machines to assemble the boxes at the packinghouse and the increasing cost of wood boxes have resulted in increased use of fiberboard shipping containers. The fiberboard containers currently used are jumble-packed with 25 lb of fruit.

With the anticipated increase in production of peaches and nectarines, California packers and shippers are interested in the feasibility of increasing the net weight of fruit packed and shipped in fiberboard containers from 25 to 35 lb without reducing the quality of the product on arrival. Limited research has been conducted on the quality effects of increasing the net weight of jumble-filled peach or nectarine shipping containers (4, 5, 6). Spurlock and Hinsch (8) have reported on the economic advantages of jumble packing peaches in corrugated fiberboard shipping containers. The purpose of this research was to determine if 35 lb of peaches or nectarines could be packed in corrugated fiberboard boxes and shipped without adverse effects on quality to receivers in the eastern United States. In addition, two fiberboard box designs were evaluated for their performance in marketing channels.

METHODS AND MATERIALS

The following boxes were tested: (1) A one-piece, tray-style, 425-lb test, double wall, corrugated fiberboard box with lid; and (2) a three-piece, Bliss-style, 425-lb test corrugated fiberboard box with double wall end panels. Inside dimensions of both boxes were 16¼ by 13½ inches and either 6½ or 8¾ inches for depth (fig. 1). The 6½-inch-depth box held 25 lb of jumble-filled fruit or 22 lb of two-layer, place-

packed fruit. The 8¾-inch-deep box held 35 lb of jumble-filled fruit. All boxes were machine formed and glued at the packinghouse (fig. 2).

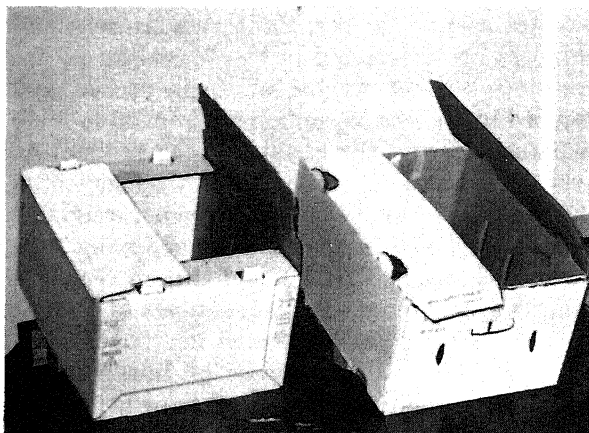
Test shipments were conducted with peaches or nectarines shipped by refrigerated truck from Fresno, Calif., to Kansas City, Mo., or New York, N.Y. The five shipments of peaches to Kansas City included 35- and 25-lb jumble-filled boxes (fig. 3). Bliss-style and tray-style design boxes were included in three of the five tests to Kansas City. Two shipments to New York consisted of nectarines jumble-filled in a 35- or 25-lb Bliss-style box or in a 22-lb, two-layer,

¹ Agricultural marketing specialist, Agricultural Research Service (ARS), Fresno, Calif.

² Italic numbers in parentheses refer to Literature Cited, p. 7.

place-packed Bliss-style box. The boxes were placed on 42- by 35-inch pallets (fig. 4). All fruit was hydrocooled before packing.

Each shipment included three sample boxes of each type. Fruit for each test was from the same field lot. Sample boxes were marked and placed in the top, middle, and bottom layers of the pallet loads for detailed examination at destination. Additional sample boxes of fruit for each type were included for distribution to selected retail stores so we could observe losses at retail, that is, after the boxes had moved through the receiver's handling system. Recording thermometers were placed in the middle box



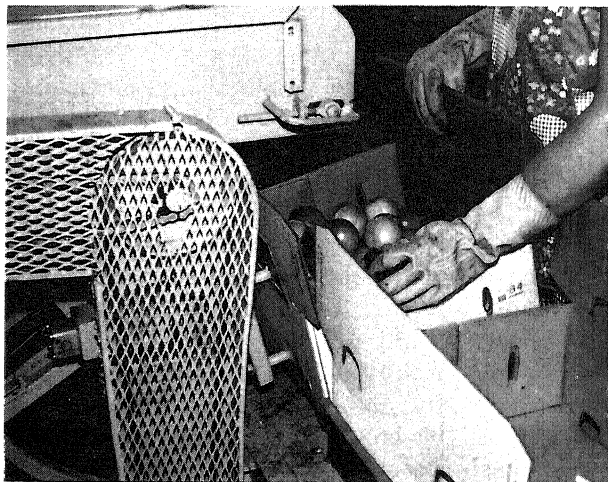
PN-5453

FIGURE 1.—Left, Bliss-style corrugated fiberboard box. Right, tray-style corrugated fiberboard box. Both boxes are 8 $\frac{3}{4}$ inches deep.



PN-5454

FIGURE 2.—Tray-style fiberboard box on automatic machine assembler.



PN-5455

FIGURE 3.—Fruit being jumble-filled into tray-style fiberboard box at packinghouse.



PN-5456

FIGURE 4.—Location of sample boxes—top, middle, and bottom—on test pallet.

of test pallets in each shipment to monitor the temperature of the air that surrounded the fruit during transit.

Fruit was evaluated for bruising, stem punctures, cuts, and decay on arrival and after ripening for 3 days at 70° F (21° C). Bruising injury was rated as (1) very slight, less than three-quarters of an inch in diameter; (2) slight, more than three-quarters of an inch but less than 1 inch in diameter (neither of these reduce salability); (3) damage, more than 1 inch but less than 1 $\frac{1}{4}$ inches in diameter (might reduce salability); and (4) serious, more than 1 $\frac{1}{4}$ inches in diameter (reduces salability). Stem

salability; and (3) serious, reduces salability.³ Firmness, measured with a Magness-Taylor pressure tester equipped with a 5/8-inch-diameter plunger, was used as the index of ripeness before shipment, on arrival, and after ripening.

on the handling of the boxes through a warehouse with permanent racks for multilayer pallet stacking and a warehouse without a rack system for storage.

RESULTS

Temperature

The average temperature, based on transit recorders, of four shipments of peaches during 40 hours of transit, was 54° F (12° C) in the 25- and 35-lb fiberboard boxes. The temperatures were similar throughout transit (fig. 5). The average air temperature during transit was 39° F (4° C). The temperature recorder malfunctioned in one test. The average fruit pulp temperature, taken with a thermometer at time of loading, was 50° F (10° C) in 25- and 35-lb fiberboard boxes. On arrival, the fruit pulp temperature in both boxes was 46° F (8° C). All pulp temperatures were taken in fruit from the center boxes on the pallet.

The average temperatures, based on transit recorders, of two shipments of nectarines during 96 hours of transit, were 48° F (9° C) for the 25- and 35-lb fiberboard boxes and 50° F

(10° C) for the 22-pound, two-layer, place-packed fiberboard box. The respective temperatures were nearly constant throughout transit (fig. 6). The fruit pulp temperature taken with a thermometer at time of loading was 51° F (11° C) in the three types of boxes. On arrival, the average fruit pulp temperature was 40° F (4° C) in the 25-lb fiberboard box, 43° F (6° C) in the 35-pound fiberboard box, and 41° F (5° C) in the 22-pound, two-layer, place-packed box. After 24 hours in the receiver's distribution system, all three types of boxes were at the retail store. The pulp temperature of the fruit was 60° F (16° C).

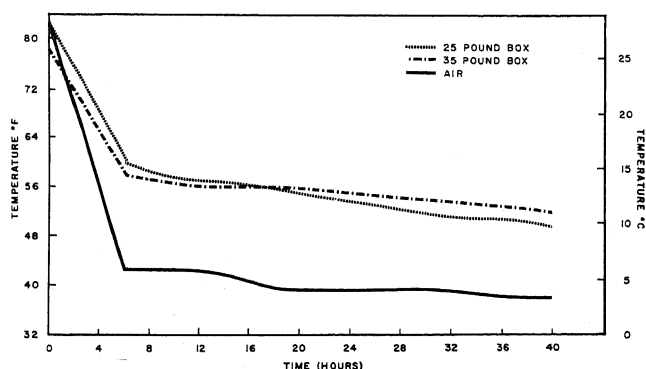


FIGURE 5.—Average transit temperature of four test shipments of peaches packed in 25- or 35-lb fiberboard boxes and shipped in the same vehicle.

³ Based on U.S. Department of Agriculture, United States Standards for Grades of Nectarines and Peaches. April 1966.

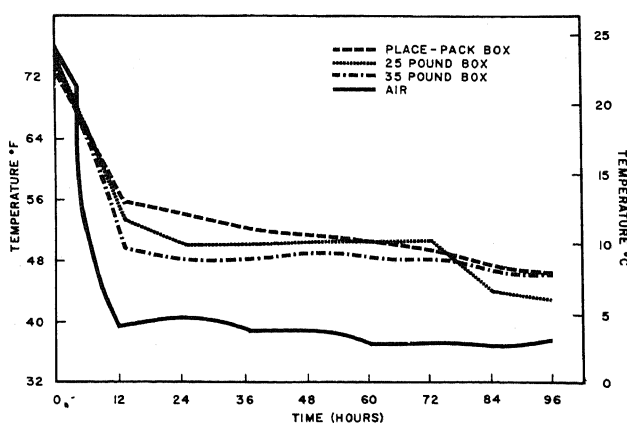
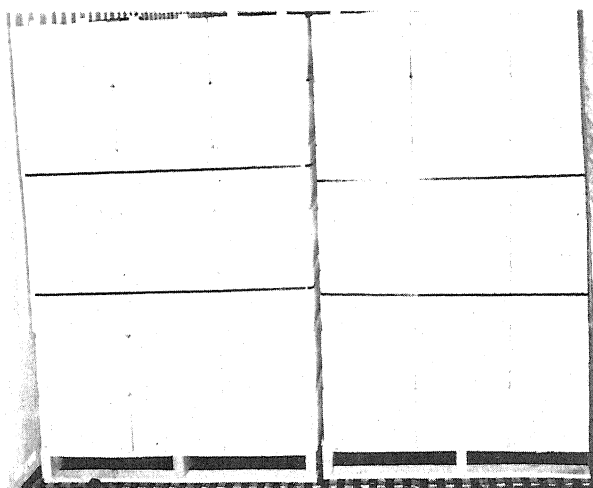


FIGURE 6.—Average transit temperature of two test shipments of nectarines packed in 25-, 35-, or 22-lb, two-layer, place-packed fiberboard boxes, and shipped in the same vehicle.

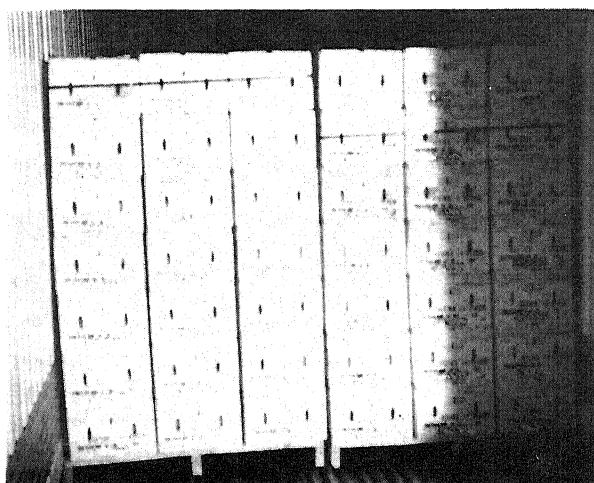
Container Condition

On arrival, all containers were in good condition and undamaged (figs. 7 and 8). No differences could be observed between the performance of the tray-style corrugated fiberboard box and the Bliss-style corrugated fiberboard box.



PN-5457

FIGURE 7.—Bliss-style fiberboard box in good condition on arrival at receiver's warehouse.

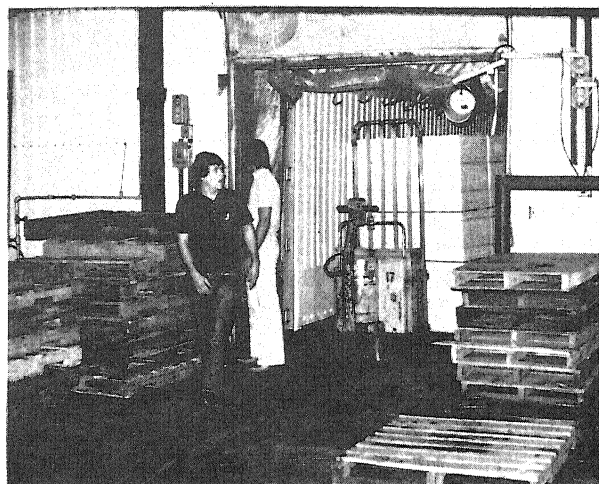


PN-5458

FIGURE 8.—Tray-style fiberboard box in good condition on arrival at receiver's warehouse.

Two systems of handling and storing the palletized shipments of fruit were observed at destination. At one receiver's warehouse, a rack system of storage was used. Full pallet loads of fruit could not be stored in the racks because of their height limitation. Therefore, the top layers of boxes were removed from each pallet and placed on 48- by 40-inch house pallets. The truckdrivers were responsible for unloading the truck and the top boxes. This method increased the amount of handling of some fruit. The warehouse provided a pallet jack to unload pallets

(fig. 9). Fruit placed in warehouse racks is shown in figure 10. The 42- by 35-inch pallet is placed on a 48- by 40-inch warehouse pallet. The other system did not utilize the racks. Warehouse personnel unloaded the truck when a unitized load arrived. Consequently, additional handling of boxes was not necessary.



PN-5459

FIGURE 9.—Truckdriver unloading palletized fruit with the aid of an electric pallet jack.

Fruit Condition and Maturity

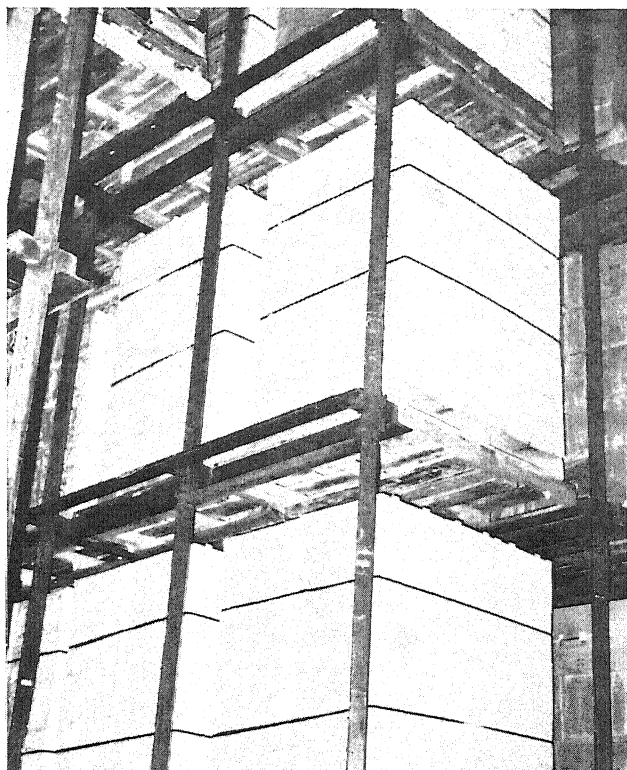
PEACHES

Injury to peaches shipped in each type of container at destination is summarized in table 1. The fruit was examined after having been ripened 3 days at 70° F (21° C). Differences in injury and decay of peaches shipped in 25- and 35-lb fiberboard boxes were not statistically significant.

The firmness of the fruit, based on Magness-Taylor pressure tests on arrival, was 20.0 and 19.3 lb in the 25- and 35-lb boxes, respectively. At time of examination after the holding period, the firmness of fruit from both boxes was 4.3 pounds.

NECTARINES

Injury to nectarines shipped in each type of container is summarized in table 2. The fruit was examined after ripening for 3 days at 70° F (21° C). Differences in injury and decay of nectarines shipped in 25- and 35-lb, jumble-filled and 22-lb place-packed fiberboard boxes



PN-5460

FIGURE 10.—Bliss-style fiberboard box palletized in receiver's warehouse racks.

were not statistically significant. However, bruising in the very slight and slight categories tended to be higher in the 35-lb box than in the other types of boxes. Less bruising occurred in the 22-lb, place-packed box than in the 25- or 35-lb, jumble-filled fiberboard boxes, although the differences were not great enough to be statistically significant.

The firmness of the fruit, based on Magness-Taylor pressure tester, on arrival was 20.7 lb in the 25-lb box, 19.2 lb in the 35-lb box, and 17.5 lb in the 22-lb, placed-packed box. At time of examination after the holding period, the firmness was 3.6 lb for fruit from all three boxes.

Condition of Fruit in Retail Store

Sixty of the 25-lb fiberboard boxes and 48 of the 35-lb boxes were placed in two retail stores. The produce departments kept a record of waste for each type box. Waste was fruit that the produce clerk considered could not be sold after

TABLE 1.—*Injury and decay of peaches shipped from Fresno, Calif., to Kansas City, Mo., in 25- or 35-lb jumble-filled fiberboard boxes and then held 3 days at 70° F (21° C)*¹

Type and degree of injury	25-lb jumble-filled fiberboard box	35-lb jumble-filled fiberboard box
	Percent ²	Percent ²
Bruised: ³		
Very slight	12.3 a	10.0 a
Slight	2.0 a	1.4 a
Damage	.5 a	.5 a
Serious	.3 a	.7 a
Stem punctures and cuts: ⁴		
Slight	2.7 a	3.1 a
Damage	.5 a	.3 a
Serious	0 a	0 a
Decay	1.4 a	1.3 a

¹ Average of 5 truck shipments in 1975 season.

² Means for a given degree of injury followed by the same letter are not statistically significant at the 5-percent level.

³ Bruised: Very slight—less than $\frac{3}{4}$ inch in diameter; slight—more than $\frac{3}{4}$ inch, but less than 1 inch in diameter; damage—more than 1 inch but less than $1\frac{1}{4}$ inches in diameter; serious—more than $1\frac{1}{4}$ inches in diameter.

⁴ Stem punctures and cuts: Slight—does not affect salability; damage—might affect salability; serious—affects salability.

each day due to bruising, decay, or overripeness. Of the 1,500 lb of peaches in the 25-lb boxes, 19 lb were considered unsalable, which amounted to a 1.3-percent loss. Of the 1,680 lb of peaches in the 35-lb boxes, 30 lb were considered unsalable, or a 1.8-percent loss.

NECTARINES

Three sample boxes—one each of the 25-lb box, 35-lb box, and two-layer, place-packed box—were sent for detailed evaluation to four retail stores, which were selected on the basis of distance from the warehouse. The fruit was not held at 70° F (21° C) for 3 days, but examined upon arrival at the store.

The type of container used to ship and distribute nectarines had no significant effect on the incidence of injury or decay at the retail level (table 3).

TABLE 2.—*Injury and decay of nectarines shipped from Fresno, Calif., to New York, N.Y., in 25- or 35-lb jumble-filled or 22-lb 2-layer place-packed fiberboard boxes, and then held 3 days at 70° F (21° C)*¹

Type and degree of injury	25-lb jumble- filled fiberboard box	35-lb jumble- filled fiberboard box	22-lb place- packed fiberboard box
	Percent ²	Percent ²	Percent ²
Bruised: ³			
Very slight	13.0 a	13.7 a	10.9 a
Slight	8.9 a	10.9 a	5.8 a
Damage	3.3 a	4.4 a	2.8 a
Serious	1.1 a	.5 a	.7 a
Stem punctures and cuts: ⁴			
Slight	4.5 a	4.5 a	4.4 a
Damage	2.6 a	1.7 a	1.9 a
Serious	.6 a	.6 a	.5 a
Decay	1.6 a	.8 a	.7 a

¹ Average of 2 truck shipments in 1975 season.

² Means for a given degree of injury followed by the same letter are not statistically significant at the 5-percent level.

³ Bruised: Very slight—less than ¾ inch in diameter; slight—more than ¾ inch, but less than 1 inch in diameter; damage—more than 1 inch but less than 1¼ inches in diameter; serious—more than 1¼ inches in diameter.

⁴ Stem punctures and cuts: Slight—does not affect salability; damage—might affect salability; serious—affects salability.

TABLE 3.—*Injury and decay of nectarines distributed to 4 retail stores in New York in 25-lb jumble-filled fiberboard boxes, 35-lb jumble-filled fiberboard boxes, or 22-lb 2-layer, place-packed fiberboard boxes*¹

Type and degree of injury	25-lb jumble- filled fiberboard box	35-lb jumble- filled fiberboard box	22-lb place- packed fiberboard box
	Percent ²	Percent ²	Percent ²
Bruised: ³			
Very slight	6.1 a	4.5 a	5.8 a
Slight	4.9 a	4.7 a	3.4 a
Damage	.9 a	2.8 a	1.3 a
Serious	.6 a	.9 a	0 a
Stem punctures and cuts: ⁴			
Slight	5.8 a	5.9 a	4.5 a
Damage	1.2 a	1.8 a	.7 a
Serious	0 a	0 a	0 a
Decay	.9 a	.6 a	.3 a

¹ Average of 4 boxes of each type.

² Means for a given degree of injury followed by the same letter are not statistically significant at the 5-percent level.

³ Bruised: Very slight—less than ¾ inch in diameter; slight—more than ¾ inch, but less than 1 inch in diameter; damage—more than 1 inch but less than 1¼ inches in diameter; serious—more than 1¼ inches in diameter.

⁴ Stem punctures and cuts: Slight—does not affect salability; damage—might affect salability; serious—affects salability.

DISCUSSION

A corrugated fiberboard box of either a tray-style or Bliss-style design will carry 35 lb of jumble-filled peaches or nectarines in good condition. However, the fruit packed must be of initial high quality and properly cooled. Fruit not properly precooled will be overripe and highly susceptible to bruising and decay on arrival at the market. The recommended transit temperature for peaches and nectarines is 34° F (1° C) (8). The refrigeration system of the transport vehicle should be in good operating condition to maintain a 34° to 35° F (1° to 2° C) temperature during transit; however, transit temperatures in these test shipments were higher than those recommended. Increasing

the depth of shipping containers to accommodate 35 lb of fruit, rather than 25 lb, tended to increase bruising slightly but not significantly. The economic advantage of the larger container to growers, shippers, receivers, and consumers may offset the slight increase in bruising. The cost of the 35-lb fiberboard box is about 17 percent more than the 25-lb box, but 29 percent more fruit can be shipped in the 35-lb box. Based on a box cost of 1.8 cents per pound of fruit for the 35-lb box compared with 2.2 cents per pound of fruit for the 25-lb box, about \$1.5 million a year could be saved by using the 35-lb box.

The peach and nectarine industry accepted the 35-lb jumble-filled corrugated fiberboard box of

either Bliss-style or of tray-style design as a standard shipping container in 1976.

LITERATURE CITED

- (1) ANONYMOUS.
1975. FRUIT TREE SALES. California Crop and Livestock Reporting Service, U.S. Dept. Agr., Statis. Rptg. Serv. 1975 Rpt., 5 pp.
- (2) _____
1975. MOVEMENT OF CALIFORNIA FRESH FRUITS AND VEGETABLES. Federal-State Market News Service, U.S. Dept. Agr., Agr. Market Serv., Market News Branch.
- (3) _____
1976. NONCITRUS FRUITS AND NUTS. Statistical Reporting Service, Crop Reporting Board, U.S. Dept. Agr. F-NT 1-3 (76), 42 pp.
- (4) HALE, P. H., and MALLISON, E. D.
1966. EVALUATION OF SELECTED SHIPPING CONTAINERS FOR EASTERN GROWN PEACHES. U.S. Dept. Agr. Market Res. Rpt. 737, 11 pp.
- (5) _____ WOODLEY, G. W., and WILSON, E. W.
1972. PALLETETIZED SHIPPING OF PEACHES FROM GEORGIA IN 48-POUND BOXES. U.S. Dept. Agr. Tech. Bul. 711, 21 pp.
- (6) MITCHELL, F. G., GENTRY, J. P., SOMMERS, N. F., and others.
1965. TIGHT-FILL PACKING OF DECIDUOUS FRUITS. Calif. Univ., Agr. Ext. Serv. Pub. AXT-173, 12 pp.
- (7) REDIT, W. H.
1969. PROTECTION OF RAIL SHIPMENTS OF FRUITS AND VEGETABLES. U.S. Dept. Agr. Agr. Handb. 195, 98 pp.
- (8) SPURLOCK, H. C., and HINSCH, R. T.
1964. COST ANALYSIS OF PACKING PEACHES IN DIFFERENT TYPE CONTAINERS FOR THE FRESH MARKET. S.C. Agr. Expt. Sta., Dept. Agr. Econ. AE 266, 35 pp.